Research Paper | Computer Science | E-ISSN No : 2454-9916 | Volume : 3 | Issue : 5 | May 2017

ROAD LANE AND EDGE DETECTION WITH GRADIENT AND HOUGH TRANSFORM

Aditya J. Acharya [1] | Sheetal Thakar [2]

[1] M.Tech Student, Dept. of Computer Engineering, Parul Institute of Engineering and Technology, Vadodara, Gujarat, India.

[2] Asst. Professor, Dept. of Computer Science and Engineering, Parul Institute of Engineering and Technology, Vadodara, Gujarat, India.

ABSTRACT

Road mischances are one of the real issues that are gambling lives of individuals. It is a dynamic field of research work to create driver help framework that can help them to drive securely and lessen the dangers of road accidents. The essential thought is to utilize progressions in the field of computer vision and create driver help framework to stay away from or lessen the dangers of mischances. For this framework first and most essential stride is the road detection. Different vision based path recognition systems have been produced in recent years. One of the significant issues that influence the framework is shadow and changing powers of sunshine. Here in this work we are attempting to defeat these issues and grow more precise and quick road detection framework that can help drivers for a secure driving. Picture casing may contain pointless items like trees, sky and so forth in which shrewd edge detection is connected as a preprocessing. Gradient based technique which gives hearty path discovery against shadow and light however initial five output line ought to be of path and it is chosen arbitrarily at introductory level for that hough change is used. For prediction of lane point Kalman channel is utilized. In this paper the dataset utilized for testing and approval of proposed technique from CMU/VASC database. Exploratory outcomes demonstrate that this technique has more resistance against shadows and low light condition and give roust and good outcome.

KEYWORDS: Edge Detection, Image Processing, Road Detection, Reputation, Lane Detection.

I. INTRODUCTION

Road path identification strategies which depend on vision have been for the most part connected in different application fields like intelligent driver assistance system, self-governing and so on. The most suitable case of this is the Lane Departure Warning System (LDWS) which is utilized when the vehicle is driven out of the way, then the vision-based path detection is utilized. The issue is not yet totally settled due to natural changeability, for example, shadows, vehicle's impediments, wearied markings, distinctive enlightenment conditions and other picture ancient rarities. Various reviews demonstrate that more than half of the vehicle collisions are brought about by drivers' diversions who either play with the music system or chatting on the mobile phone while driving. Lane Detection has in this manner turn into an undeniably vital region of research.

Road detection is considered as a fundamental module for the Driver Assistance System. These calculations are the center of road lane departure assistance systems and road lane keeping system. What's more, data about the distinguished road lane position can be utilized to identify moving vehicles and obstructions. All path location calculations utilize the accompanying three stages: road lane extraction, removing of outliers, and the tracking system. Among them feature extraction is a critical stride in road lane identification. In the event that the component is not effectively recognized, it is hard to repay amid post-processing. Many components, for example, different colors[3], corners[16], edges and geometric shapes[4] can be utilized to recognize lanes. Edges are a standout amongst the most huge components since road lanes make solid edges out and about. At the end of the day, huge gradient intensity exist between the road and the lane because of the distinction in their respective intensities. For that purpose we can use gradient based method[3].

The main properties of lane marking (or boundary) detection techniques should possess are:

- The nature of road lane detection must not be influenced by shadows and it can be cast by trees, structures, and so forth.
- It should be proficient to process the painted and the unpainted roads and lanes.
- It should deal with the curvy roads instead of expecting that the roads are straight.
- It must utilize the parallel constraint as a direction to enhance the identification of both sides of path markings even with noisy images.
- It ought to create an explicit calculation of the reliability of the outcomes acquired.

Road lane and edge detection has therefore become an increasingly crucial area of research.

II. RELATED WORK

Lane detection algorithms are basically classified in to two categories i.e. model based approach and feature based approach[1,2].

The Model-based framework starts with choosing a model or layout for the road lane, signifying parameters to represent the road lanes, and fitting the model to the extricated parameters and processing. Linear, spline, parabola are the model based techniques. Application to these techniques are restricted to some road situations and cannot perform well within the sight of shadows and low brightening condition.

The gradient feature based technique for road lane and edge identification is present by Parajuli et al.[1]. This system give efficient path detection against shadow and light. Yoo et al. presented technique which give strong road lane detection[2] in different light condition however it doesn't works in multi-enlightenment condition. Sridevi et al. proposed edge feature based techniques to distinguishing the road lanes and applying hough transform [3] through find proficient outcomes. Aung, Thanda, and Myo Hein Zaw presented the hough transform method [5] which give road lane discovery in poor brightening additionally yet not pertinent to constant application. Mc Donald et al. [3] presented distinctive edge techniques through discover road lane and edge. These strategies have encountered challenges while picking a reasonable intensity threshold to evacuate the undesirable edges. Robust lane detection during the evening which depends on transient frame averaging, edge identification and hough transform exhibited in layered approach is proposed by wang et al[16]. The calculation is quick, robust, and can be utilized as a part of ongoing applications. Vigilant edge location can be utilized to distinguish the lanes of roads. Lord Hann LIM et al. proposed Kalman filtering it is otherwise called straight or linear quadratic estimation (LQE), it is a calculation that uses a progression of estimations watched extra minutes, containing commotion (irregular varieties) and different errors and produces assessments of obscure factors that have a tendency to be more exact than those in light of a solitary estimation alone. The Kalman channel works recursively on floods of loud info information to deliver a factually ideal gauge of the underlying system state.

III. GRADIENT FEATURE BASED PROPOSED METHOD

There has been advance in identification of road lanes and edges of different shapes however there a requirement for powerful recognition of road lane in nearness of shadows and different antiquities. Along these lines, combinational approach of different technique disclose in this work to enhance the execution of different road lane detection system techniques. One of the best approach to enhance the performance is consolidate approach of both the neighborhood inclination include based and hough change based technique. Inclination highlight based technique [1] give strong path identification in nearness of shadow and illumination yet just the barrier is that the initial five points of the image need to choose arbitrarily and it must be of the road lane, the error of initial five scan line can't be taken care of and prediction from that is likewise false. In this strategy utilize the hough transform method to give initial seed which is old and change the pattern detection issue into less demanding pinnacle point detection issue. In this way on the premise of literature review of both systems it can be concluded that

the performance of path detection will improve. The basic block diagram of this proposed method is as shown in figure. At first, canny edge detection is used to detect the edge and gradient intensity of an image to enhance the same. Then hough transform is applied on detected edges.

From detected line segment, five points are given to the gradient feature base method as initial seed. Then gradient of an image is found and gradient function match plotted which give lane points. A simple linear prediction model is used to predict the direction of lane marks on the road. The importance of this method is the use of vertical gradient image without converting into binary image and introduce characteristic lane spectrum within the local window to locate the exact lane marking points along the horizontal scan line over the image. This method present lane boundary detection method which is not affected by shadow and uneven illumination. This method is explained in detail as follows.

A. *Canny Edge Detection*

Steps of canny edge detection algorithm:

1. Gaussian Smoothing
2. Gradient Analysis
3. Non-maximum Suppression
4. Hysteresis Thresholding
5. Edge Linking

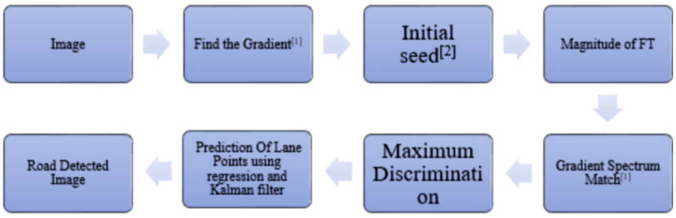
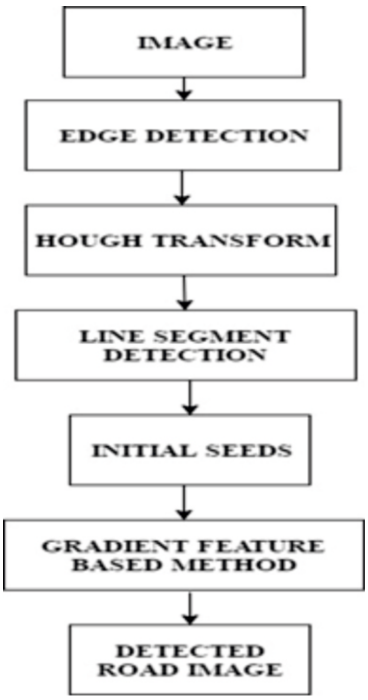


Figure: 1 Proposed method

The proposed method initiates with calculating the vertical gradient of the image and processing is done in this vertical gradient image. The vertical gradient is taken to remove the effects of shadows along the road and lane which are usually horizontal. This method does not require threshold to convert the gradient image into binary image and unaffected by illumination conditions and shadows.



B. *Feature Extraction*

The vertical gradient[1] of an image is obtained by 2D discrete convolution of an image I(m, n) with h(m, n).

$$G(m,n)=I(m,n)*h(m,n) \qquad \text{……..(1)}$$

Where h (m, n) is a mask given by

$$h(m,n) = \begin{bmatrix} 1 & 1 & 1 \\ 0 & 0 & 0 \\ -1 & -1 & -1 \end{bmatrix} \qquad \text{……..(2)}$$

In the spatial domain, a window of size 15x15 is selected and placed at given seed point from the detected lane segment using Hough transform, points s1, s2, s3, s4 and s5. All the points within these five local windows are placed in five different matrices namely w1,w2, w3, w4 and w5.Then the magnitude of FT (Fourier Transform)of these five matrices is computed and their average is calculated. This average value of the magnitude of FT is the characteristic spectra for the lane markings and will be represented as Lspectra. The variable Lspectra used further in this discussion will refer to the characteristic spectra of the lane markers. Analysis of result for different window dimension indicated the 15x15 size window produced most consistent and accurate representation of distinguishing road lane markers from background settings. The spectra for the lane markings are characteristic to the respective lane and invariant to the selection of location on a given lane marking (independent of translation, rotation and scaling). The characteristic spectrum is obtained from the first frame of the video file from the image database. This spectrum (Lspectra) is consistent for all the images from the database[15]. The characteristic spectrum of lane marking is obtained from the first frame, it do not require to obtain the characteristic spectra from all the successive frames for a period of time.

C. *Gradient Spectrum Match Function*

The gradient spectrum match function is used to locate the precise points on the adjacent lanes in which the vehicle is moving. The 15x15 local window is moved along the horizontal scan line and magnitude of FT over the local window is calculated as represented in Equations 3-5. Let I(n1,n2) be the gradient image with the following dimensions.

I(n1 ,n2,) where, n1 and n2 are discrete variables in the range,

$$1 \le n1 < R,\ 1 \le n2 \le C \qquad \text{………(3)}$$

The sliding window is placed at each point along the horizontal scan line and corresponding gradient values of image I (n1,n2) within the window can be represented by variable p as in the Equation 4. Along the horizontal line the row component of the image i.e. yp (i) = y (i) is fixed and only the n2 changes along the scan line from 1 to C.

$$p=I(n1+k,n+1) \qquad \text{…….(4)}$$
$$-7\le 1\le 7,\ -7\le 1\le 7$$

$$p = FT\{P\} = FT\{I(n1+k,\ n+1)\} \qquad \text{…….(5)}$$

Then the variable P = FT {p}generated at a given point (n_1,n_2) is correlated with the characteristic spectrum Lspectra and the maximum value is chosen. This maximum value is R (0, 0) and can be obtained by element wise multiplication of Lspectra and P as shown in Equation (6). The maximum correlation is calculated at each point along the horizontal scan line and stored in a variable Sm (n_2) where n_2= 1,2,…..C. The normalized plot of Sm for all the values of along the horizontal line is called Spectrum matching plot.

$$R(0,0) = \sum_{i=-7}^{i=7} \sum^{j=-77} Lspectra\ (i,j)\ P(i,j) \qquad \text{……..(6)}$$

$S_m(n2) = R(0,0)$ where, n2 = 1,2,3….C

D. *Processing of Spectrum Match (Sm) Plot*

The spectrum matching plot (Sm) is smoothed with Moving Average (MA) filter of order 20 and the maxima points on the plot are found.To remove the unnecessary processing of maxima points, threshold value is considered 0.3(if Sm(i) < 0.3 then Sm(i) = 0). Threshold helps in the removal of unnecessary maxima points.

E. *Linear Prediction of Lane Points*

After the first five horizontal scan lines are drawn, the left and right lane points on the next scan line are estimated using a simple linear prediction model. The variable we are predicting is called the criterion variable and is referred to as Y. The variable we are basing our predictions on is called the predictor variable and is referred to as X. When there is only one predictor variable, the prediction method is called simple regression. In simple linear regression,the predictions of Y when plotted as a function of X form a straight line.

IV. OBSERVATIONS, RESULTS AND ANALYSIS

The algorithms explained in section 3.2 were simulated on laptop Intel(R) Core(TM) i5 with 4.00 GB RAM running under 64-bit Windows 7 operating system. The software used for simulation was MATLAB R2013b and the results of road image are as shown below.

1 Read the image

Figure 2: Straight road image with shadow

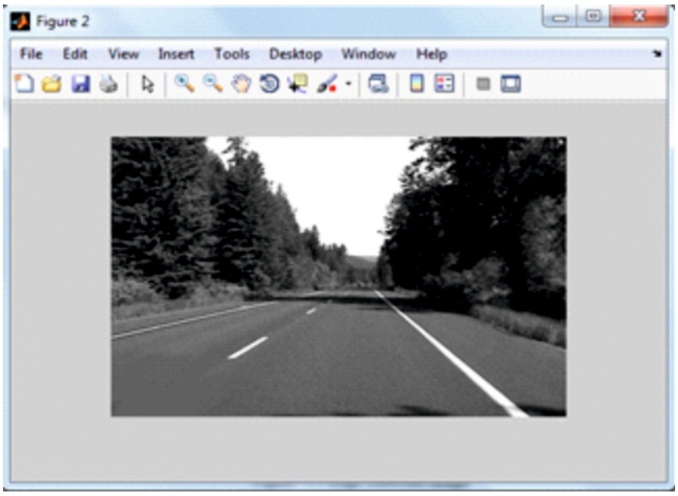


Figure 3: Image pre-processing

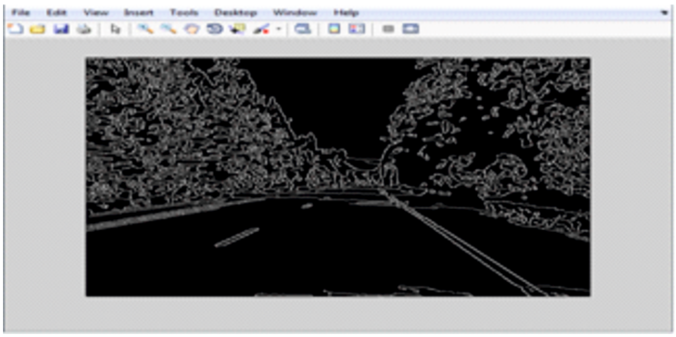


Figure 4: Edge Detected Image

Matlab Results:

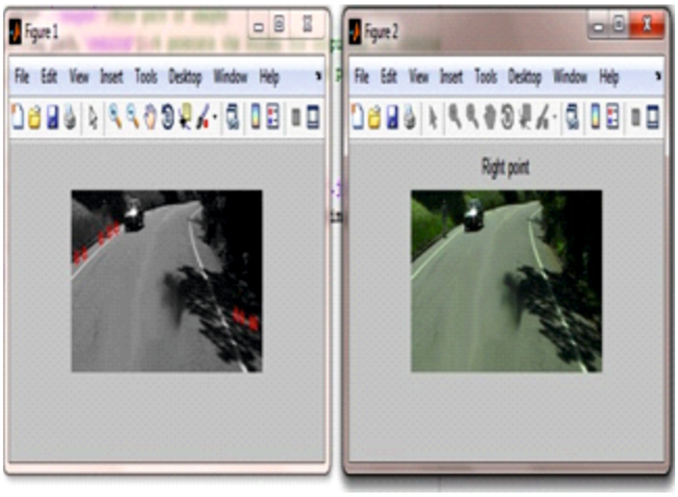


Figure 5: Selecting Right points of shadow image

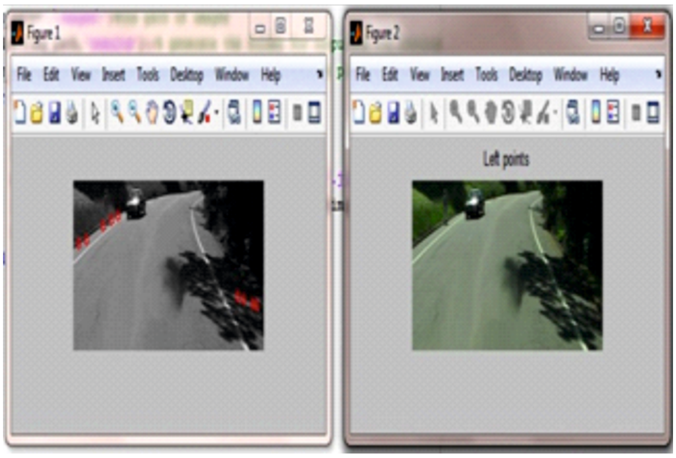


Figure 6: Selecting Left points

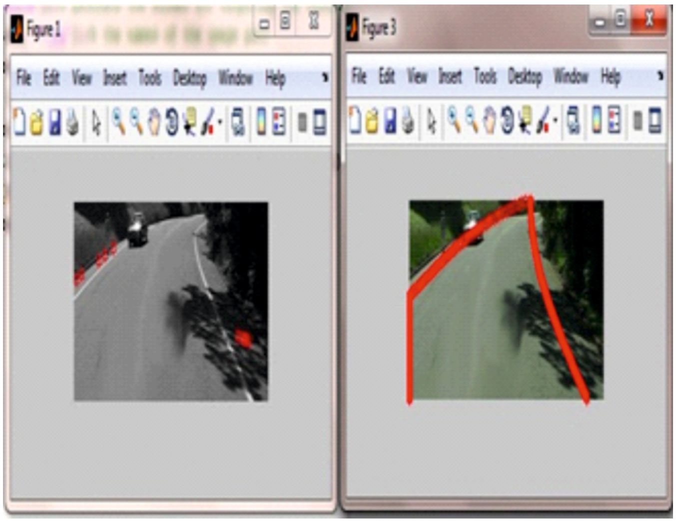


Figure 7: Detected Road Lane of shadow image

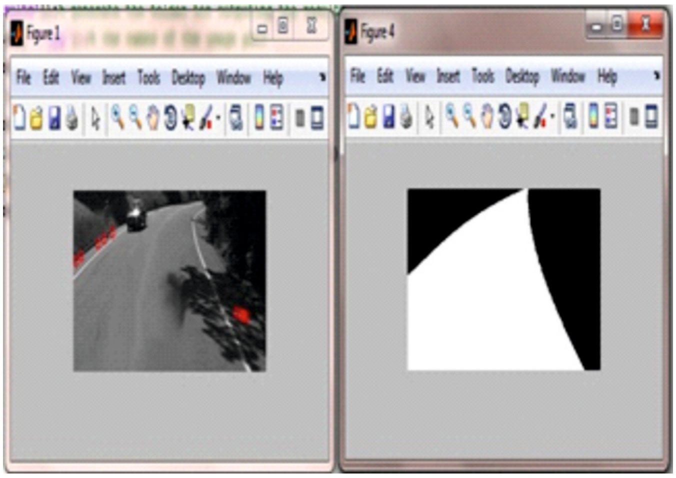


Figure 8: Road detected using Kalman Filter

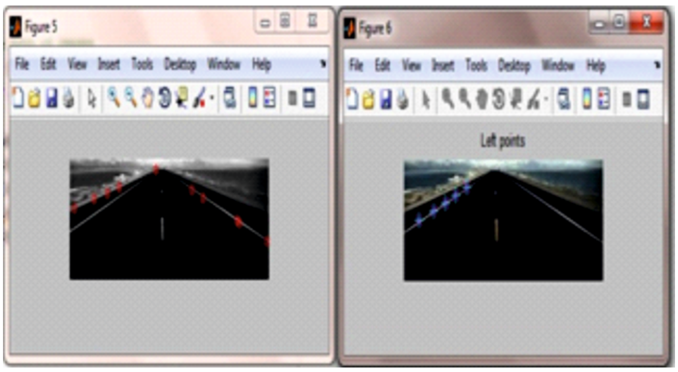


Figure 10: Selecting Left points of straight road

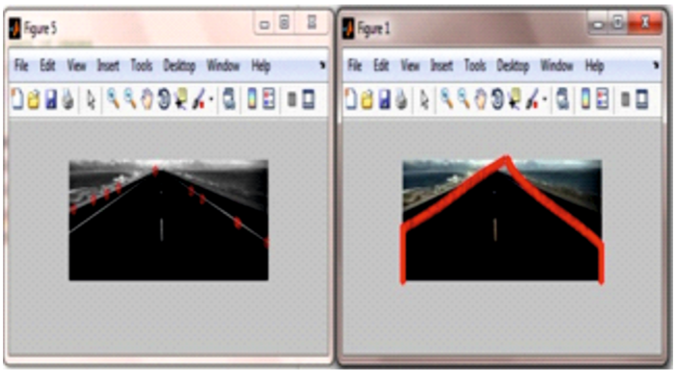


Figure 11: Detected Straight Road

$$Recall = \frac{TP}{TP+FN} \quad \text{.......(12)}$$

$$Precision = \frac{TP}{TP+FP} \quad \text{.......(13)}$$

$$Accuracy = \frac{TP+TN}{TP+TN+FP+FN} \quad \text{.......(14)}$$

TP - Road is detected as road
FN - Road is detected as non-road
FP - Non road is detected as road
TN - Non road is detected as non-road

Recall is fraction of the actual lane stripes to the detected lane stripes. Precision is the fraction of the detected lane stripes to the actual lane stripes. Accuracy the measure of the how well the lane stripes are correctly detected compared to other algorithms. Comparision of the proposed algorithm with gradient method[1] is presented in Table 1.

Table 1: Comparision Evalution parameter of gradient method and proposed method

Evaluation Parameter	Gradient Method[1]	Proposed method Using hough transform and regression
Recall	71%	83%
Precision	74%	76%
Accuracy	63%	73%

Performance analysis of the proposed system using regression for prediction gives efficient and improved results than gradient method[1] that we can observe from Table 1. Proposed algorithm gives 10% more Accuracy than Gradient method.

V. CONCLUSION

This paper conclude approaches for the detection of road lane markers based on gradient feature based method. At first the combination of Hough transform and gradient feature based method is used where initial seed points to gradient feature based methods will be taken from hough transform based approach and the experimental result suggest that this method is good for lane detection in presence of shadow. The experimental results indicate that the proposed method provides a robust detection to road lane.

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